Acoustic shock in call centres

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ABSTRACT

An estimated 220,000 telephone headset using workers are employed in about 4000 Call Centres across Australia. Call Centres annual attrition- and average turnover rate (23%), is higher than the general industry average of 18%. This has been attributed to poor working conditions, health and safety issues, and stress. Occasionally Call Centre telephone operators experience acoustic incidents such as a sudden loud shriek or piercing tone through their headsets. Where these cause symptoms like; a startle reflex, tingling, dizziness and nausea, headaches, fullness of hearing or tinnitus, the operator has experienced an acoustic shock. The sounds originate either from line faults, misdirected faxes, power supply failures, or manmade sources, e.g. frustrated customers. Despite these sounds seldom being loud enough to cause physical damage to the inner ear's hair cell structures, their effects on the operator can be devastating and considered directly related to the level of stress the operator experiences. Effects range from simple annoyance to incapacity to continue work or never again being able to work with headsets. Audits of Call Centres revealed inadequate (acoustic) environments, and acoustic incident protection, follow up measures and training. Call Centre managements must ensure that adequate control measures are in place.

INTRODUCTION

Most call centres operate as open office type environments in which workers (telephone operators) conduct work mainly by using telephones to; sell products, conduct surveys, provide a service and/or answer enquiries from callers. Telephone operators in call centres predominantly use headsets to communicate with clients as this allows them to do other things like inputting data into computer systems. Perhaps the most important distinction between a call centre and other workplaces is that there is no interface between clients and an operator, i.e. no visual, eg eye, or tactile, eg handshake, contact and the business is conducted at a purely auditory level. Call centres represent the most rapid growth of any industry in the world with an estimated 220 000 telephone headset using workers (2.2% of the Australian workforce) currently employed in more than 4000 call centres across Australia. Of these the large majority are female. Despite this rapid growth and the associated opportunities for employment, call centres are reported to have high attrition rates with an Australian average turnover rate of 23% annually (compared with the general industry average of 18%). This comes at a cost of over $550 million to the industry. The high attrition rate has been attributed to poor working conditions, including health and safety issues and, in particular, stress (*statistics: www.callcentres.net)*.

Occasionally call centre telephone operators experience acoustic incidents such as sudden loud shrieks or piercing tones through their headsets. A study conducted by the Health and Safety Executive in 2001 (HSL 2001) indicates that the loud noises heard by the operator are seldom loud enough to damage the hair cell structures of the inner ear. The signals in modern telephones are limited to 120dB SPL or 123dB Peak (AS/ACIF S004: 2001). These levels are well below those considered to cause damage to hearing, depending on the duration of exposure. However, the 'normal' voice level may be disrupted by a sudden and extraneous noise that causes a sharp increase in noise level and temporary hearing loss, dizziness and nausea may result. An example of this was investigated recently by the author where a telephone operator was talking to a client who used a mobile phone in a workplace when suddenly a loud screeching sound occurred at the workplace end. The telephone operator reported experiencing a 'startle effect' followed by nausea, vomiting, dizziness and tingling at the left side of the face and tongue, headache and feeling anxious and teary. The acoustic signals can have effects on telephone operators, which are considered to be directly related to the level of stress in the operator. Effects can range from simple annoyance to incapacity to continue to work, often for periods ranging between a few hours to never again being able to do work involving the use of headsets.

There are some reported cases of operators affected by loud piercing noise from early model cordless telephones (Orchik et al 1987, Guot 1988). These telephones had the ring tone in the earpiece and because of this and the absence of limiters, they produced much higher noise levels (>140dB) than would be experienced by a headset user and caused symptoms more consistent with acoustic trauma. Acoustic shock as experienced by telephone headset users in call centres therefore is different from the acoustic trauma experienced by the users of the old type cordless phones. The sound levels in headsets are well below the legal exposure limits and too low (<120dB, SPL at the eardrum) to cause acoustic trauma of the kind normally experienced from impulsive sounds.

ACOUSTIC INCIDENT- ACOUSTIC SHOCK

ACIFG616: 2004, Guideline-Acoustic Safety for Telephone Equipment, defines an acoustic incident as:

> The receipt by a telephone user of an unexpected sound that has acoustic characteristics that may cause an adverse reaction in some telephone users. Depending on the characteristics of the sound and the user, an acoustic shock may result from the incident.

From this definition it follows therefore that an acoustic incident is not per se an acoustic shock. An acoustic shock is defined by ACIFG616: 2004 as:

> Any temporary or permanent disturbance of the functioning of the ear, or of the nervous system, which may be caused to the user of a telephone earphone by a sudden sharp rise in the acoustic pressure produced by it.

An acoustic shock is usually experienced as a loud noise such as a shriek, screech, squawk, or howl. The severity outcome

of the experience is usually the result of a combination of the unwanted interference on the telephone line and the psychosomatic and physiological responses to the acoustic incident.

The high-pitched tones can affect anyone using a telephone but people using a hand-held telephone are less likely to be affected. It is quicker to move a handset from the ear than a headset. Headset wearing operators are therefore likely to receive a greater noise exposure than people using handsets. Factors contributing to the severity of an acoustic shock experience are considered to include the office environment e.g lay out, equipment, training, monitoring systems, targets to be met, absence of protection systems, and background noise.

Symptoms of acoustic shock

Acoustic shock occurs where it takes the form of a temporary or permanent impairment to any of the ear's structures or associated nervous systems. Patuzzi et al (2001) report that

> A "typical" incident may involve the occurrence of one high-intensity, high frequency monaural squawk, without warning (around 2–3 kHz, level below 120dB SPL). The consultant removes the headset in seconds. In extreme cases they 'fall' to the ground immediately, and quickly experience a varied combination of tinnitus, vertigo, feeling of fullness in the ear, hearing loss (in very few cases), numbness, tingling, tenderness or soreness around the ear and neck, ear pain and often burning sensations.

In this author's own investigations of incidents in a number of call centres the affected telephone operators have reported some or all of the above symptoms. They also reported tingling sensations at the neck and down the arms, and to the (affected) side of the tongue. Often they confused the tingling's neurological origine with an electric shock experience.

Telephone operators who have received an acoustic shock are in a vulnerable state immediately after the incident. This vulnerability can be greatly reduced if appropriate reporting and response systems are in place including, where necessary, referral to an audiologist or ear nose and throat specialist as soon as possible. Call centre managements should also be aware that secondary symptoms are likely to occur within a few days after the incident which appear consistent with stress from trauma and include headache, anxiety, feelings of vulnerability, teariness, and apprehension about returning to telephone duties. Rehabilitation of the affected worker must aim at a quick return to the workplace and include initially alternative duties away from the telephone. Where no appropriate systems are operating tertiary symptoms may also develop. These include typically anger, hypersensitivity to loud sounds, depression, and anxiety, because of the inability to predict the next incident. Inappropriate protection, response and rehabiltiation systems have led to litigation in the UK where call centre workers have been awarded substantial amounts of compensation (Simpson & Millar 1998). Compensation of affected call centre telephone operators is a problem in Queensland, and perhaps in the rest of Australia, as there is currently no classification for acoustic shock under the workers compensation scheme.

A review by Milhinch and Doyle (2000) of 104 cases in Western Australia showed that

> 81% experienced pain, 50% tinnitus, and 38% hypersensitivity to sound. Other symptoms were, headaches 9%, vertigo and nausea 15%, other sensations 13%, sensitivity to either sound or touch, 9%, numbness 10%, hearing loss 5%, and shock anxiety and depression was experienced by 3%.

The high incidence of pain is believed to occur because of inappropriate stimulation of the nerve fibres in and around the eardrum. With a normal aural reflex we do not feel pain. However, in hypersensitive people the tensor tympani muscle (causing a startle reflex) contracts at lower levels than normal and because of the startle reflex the contraction may be more forceful and cause pain. Klockoff, (1973) cited in Patuzzi et al (2001), stated about the reflex "*This is a psychosomatic syndrome due to increased psychic tension caused by mental stress*", indicating that stress exacerbates the situation and stress management strategies form a crucial element in the control of the outcomes of acoustic incidents.

Apart from technical provisions the management of acoustic shock must concentrate on the psychosomatic and physiological factors, as there is no single cause for the symptoms experienced. The main cause of the psychosomatic factors is stress caused by the work pressures and environment in which the work is conducted. Stress levels are notoriously high in the call centre industry because of the way in which the business is conducted, workplace provisions and conditions, monitoring systems applied and the attitudes of some call centre managements. There is also conflict between the economic pressure of dealing with the customer adequately and having to get people off the phone quickly. The worker's perception of lack of control over the stressful working conditions and the inability to anticipate when an acoustic incident may occur is conducive to causing stronger physiological responses (eg, startle reflex), when an acoustic incident does happen than if a similar sound occurred in industry, where the sound was anticipated. Research indicates that the startle response threshold is lower in people who are anxious or stressed. The startle response threshold can, according to Blumenthal and Goode (1991) be as low as 60dB.

The main physiological response to an acoustic shock is in the middle ear mechanism. The middle ear contains two muscles, the stapedius muscle and tensor tympani muscle. These two muscles have different muscle tissue and neurological circuits however, both muscles react when loud sounds occur. The stapedius muscle is a straightforward muscle that reacts to loud sounds (> 80dB SPL) by contracting. When it contracts it puts an increased pressure on the oval window membrane of the cochlea and the movements of the stapes.

The tensor tympani muscle operates on a different neurological circuit. It responds not directly as a result of an acoustic stimulus but is actually a startle reflex. The tensor tympani muscle's reflex threshold can apparently be 'reprogrammed' to react at much lower sound levels. If triggered, it restricts the movements of the malleus and incus and is capable of placing large forces on the alignment of the eardrum. In extreme cases this may lead to a tearing (fistula) of the oval window membrane and subsequent leaking of fluid (perilymph) from the cochlea. However, Patuzzi et al (2001) believe that acoustic incident sounds alone cannot cause a tearing of the inner ear window membranes, as the middle ear bones' movement is less than a micron. They believe that there must be a predisposition to weakened inner ear membranes due to for instance, inflammation, barotrauma after recent airline travel, snorkelling, or scuba diving incidents relating to pressure variations and not equalising properly. They consider that it is therefore more likely that a combination of excessive contraction of the middle ear muscles due to an acoustic incident and the additional forces associated with a fright (tensor tympanic startle reflex) may

exacerbate the tearing of the membrane. The rare cases of fistula may be due to stapedial muscle contraction tearing a weakened oval window on its anterior edge (after previous inflammation or barotrauma) (Patuzzi et al 2001).

MANAGEMENT OF ACOUSTIC SHOCK

To manage the effects of acoustic incidents and demonstrate compliance with occupational health and safety (OHS) legislation three main elements must be incorporated. These are the work environment, including training and systems of work, workplace design, including acoustic requirements, and technical control systems, including compliance with telecommunication requirements and shriek rejection devices such as volume limiter amplifiers and controlled power supply systems.

Workplace environment

Under OHS legislation requirements all workplaces must have a number of amenities in place. These relate to things like ventilation, lighting, temperature and humidity, the provision of meal places, drinking water and first aid. Other requirements relate to the provision of space, appropriate furniture (work station set up), the use of visual display units (VDUs) and telephone headsets. Air quality and relative humidity in call centres are particularly important as they are generally the least appreciated causes for health problems but the large number people and VDUs in the room create their specific problems for the health and well being of the occupants. Air quality is important as without an adequate fresh (including recycled filtered and purified) air supply the call centre air may become stale and contaminated, increasing the risk of airborne pollutants such as irritants, carbon dioxide, bacteria and viruses which can affect workers' health. VDUs generate heat and can reduce the relative humidity in the room to unacceptable levels. Low relative humidity may lead to dehydration and in turn to sore eyes, tiredness, lethargy, headaches, dry or itchy skin and loss of voice. Low relative humidity also increases the problem of static electricity. The relative humidity in call centres should generally be between 25 and 60%. The temperature in an air-conditioned call centre should be maintained in summer at between 19 and 24^0C, and in winter at between 22 and 24^0C.

Other aspects for creating a good work environment involve organisational factors such as job induction training, job variation, breaks in a pleasant and bright lunchroom etc, toilet breaks, appropriate performance monitoring systems, management and worker training pertinent to the job and the need for quiet work conditions, use of headset equipment with a volume limiting amplifier to intercept and reduce any sudden increase in noise levels within a specified time, supervisor and worker training pertinent to headset use including the event of an acoustic shock and its expected follow up procedures.

Stress

Research into stress and absenteeism by ACA Research found that more than 36% of call centre telephone operators admitted to taking time off from work due to stress, even though they may not have given this as a reason (www.callcentres.net). Stress is the result of the workers' adverse reaction to excessive pressures and other work conditions put on them. Work stressors that cause significant harm to an individual usually result from a series of exposures. When people are stressed their bodies' immune system run down and they are therefore more susceptible to viruses such as the flu and colds. Other symptoms of prolonged work related stress may include, psychological effects such as depression, anger, anxiety, apathy, burn out and poor concentration, difficulties sleeping, chronic fatigue effects and behavioural problems such as substance abuse and aggression. They have subsequently more difficulties coping with their workload, which will stress them even further and a catch 22 situation has been created. On top of this they know their performance is being monitored at all times.

Positive ways of reducing stress in workers include providing them some freedom in deciding when to take a lunch break and short breaks from telephone duties. During those short breaks the operator can do other duties. Mini breaks, such as getting a glass of water or a toilet break not only provide some relief from telephone work, they also provide relief for the eyes and voice and allow the muscles and body parts that have been inactive due to a prolonged sitting posture to overcome fatigue. To proactively manage stress at work call center management should implement a risk management process, which systematically looks for what the problems are and what systems need to be put in place to overcome the problems.

Performance monitoring

Most industry employers have recognised the long-term negative effects of close monitoring of workers on their job satisfaction levels, the product output and on worker / management relations. This has led to a move away from close worker monitoring and control. Yet despite these negative aspects, the call centre industry has embraced close monitoring of workers as its primary tool for the control of almost all aspects of their human resources management. Monitored employees have reported higher levels of stress than unmonitored employees. However, the relationship between performance monitoring and stress is not straightforward. Some call centre workers argue that being monitored threatens their privacy increases the pressure on productivity and is an inherently negative and therefore stressful experience. Other workers argue that the stress does not arise from monitoring per se but from poor job design, which is commonly associated with electronically monitored tasks (HSE, 2001). The close monitoring of workers' performance and subsequent loss of control over one's work has very serious implications for the individual worker's long-term psychological and physiological health and wellbeing and quality of life. Workers and their representatives should therefore be consulted about the monitoring systems, their purpose, and the setting of targets because of the risks to their health and safety.

Performance monitoring also does have positive elements as it is a means of collecting more objective information about a telephone operator's productivity on which to base feedback. The feedback can be used to re-enforce the positive elements of job design and to improve the telephone operator's performance. Poor or deteriorating performance can be identified quickly and addressed.

Training

As applies to any employer, it is a duty of call centre management to provide their workers with adequate information, instruction, training and supervision. Management cannot rely for instance on the fact that the telephone operator was experienced and therefore did not need training. Any worker, no matter how experienced must be provided with this basic standard of care. The training of telephone operators and their supervisors should, apart from the normal induction training, include among others, components on acoustic incidents and acoustic shock. This

should include recognition of what constitutes an acoustic incident and the symptoms of acoustic shock. Ideally there should be included samples of sounds to which the trainees can safely listen. Such samples could include for instance, line faults, a fax signal and feedback oscillating tones. Other components must include the action to take following an acoustic incident or shock.

It is vital that call centre have systems in place, and communicated so that telephone operators and their supervisors know what action to take following an incident. It is expected that appropriate follow-up action includes apart from the reporting of the incident, at least things like referral procedures for audiological assessment, rest for the affected ear, temporary duties away from the telephones, rehabilitation based on the individual's experience, etc. This will minimise the anxiety levels in the affected person and in turn assists in a speedier return to work of the telephone operator. The training should also include proper fit, hygiene, maintenance and use of headsets to reduce feedback, the need for keeping conversation levels down and the volume levels of the headset amplifiers as low as possible.

Workplace design

The ability to communicate effectively is very much determined by the construction of the call centre interior, the headsets used and the signal to noise ratio in the call centre produced by the activities and proximity of people talking at the same time. The acoustic conditions in the centre must be made optimal with sound absorbent surfaces of floors, walls and ceilings to improve the intelligibility of telephone conversations and reduce the need for loud talking.

AS/NZS 2107:2000 Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors, in Table 1 under 5, "Office Buildings" states the recommended "satisfactory" and "maximum" design sound levels in L_{Aeq}, dB(A), for call centres, that is, a satisfactory level of 40dB(A) and maximum level of 45dB(A), and reverberation time between 0.1 and 0.6s, in the unoccupied state but with building systems operating. Surveys conducted by the Health and Safety Laboratory of the HSE in 15 call centres, found a mean background noise level of 62dB(A) with a maximum of 66dB(A) (HSE 2001) in the occupied state. This author's own noise surveys of some call centres indicate a mean background level of 66dB(A) with a maximum of 71dB(A) .

Where panels or screens are used between desks they should be of an acoustic quality in accordance with AS/NZS 4443-1997 Office Panel Systems-Workstations. The sound absorption coefficient should not be less than 0.6 and the sound transmission class (STC) rating not less than 20

Other factors influencing the speech intelligibility are accent, lack of familiarity with a language or the vocabulary used by either the caller or the telephone operator and the complexity of the subject about which the call is made. This is particularly true with for example older people calling about modern Internet banking. This takes time to explain and the call centre telephone operator is under instruction (and monitored) to limit the duration of the call to a maximum of say 200 seconds.

Technical provisions

Modern telephone systems as typically used in call centres are likely to comply with the provisions of AS/ACIF S004: 2001, Voice Frequency Performance Requirements for Customer Equipment and are therefore limited to a maximum level of 120dB SPL at the eardrum. At 120dB(A) it takes 8 seconds before the $L_{Aeq,8h}$ 85dB(A) exposure limit is exceeded. Health and safety audits conducted on a sample of call centres, including a large insurance company, revealed a belief that because telephones are limited there is no need to have a volume limiter amplifier in the telephone-headset system of operators. There is also a popular belief that the PABX system will catch any glitches that may occur. This attitude effectively leaves the telephone operator without protection from acoustic shock.

To protect the telephone operator from acoustic shock a device should be incorporated between the telephone and headset which actively monitors the incoming signals for high pitched acoustic tones and rejects these tones within milli seconds without much interference with speech signals. Such devices are commonly known as volume limiter amplifiers and several brands and models are commercially available. Volume limiter amplifiers must also have a provision for setting the upper level at which sound is allowed, e.g 85- 90 or 95dB. This enables adjustment for audibility in background noise in the call centre.

Volume limiter amplifiers may be powered by batteries or mains power. Battery powered units have the advantage that they operate independently of mains power and are therefore not affected by power fluctuations such as surges, brownouts or blackouts. Mains power operated units are affected and this has led in the past to acoustic incidents and acoustic shock experiences by telephone operators because of feedback signals generated in the equipment. Where volume limiter amplifiers are mains powered these units must be protected so that regardless of power fluctuations the power supply is maintained until such time that either mains power is restored or an emergency generator kicks in. Surge protectors, which are typically used with sensitive equipment, only protect against increases of mains power. They do not protect against dips or no power, and systems like an uninterrupted power supply (UPS) should be considered for this. A UPS consists basically of a back-up battery power supply with a capacity to hold mains power voltage for a certain period of time. Individual operators' telephones should be protected via the uninterrupted power supply from power fluctuations.

HEALTH & SAFETY REQUIREMENTS FOR ACOUSTIC SHOCK MANAGEMENT

Under occupational health and safety legislation employers have a duty of care to ensure the health and safety of each of the employer's workers and others, such as labour hire workers, who come onto the workplace to conduct work (under the direction of the employer). Call centres should therefore be able to demonstrate that risk assessments have been conducted for a range of issues, including the management of acoustic incidents and acoustic shock, that control measures have been implemented, are operating and the risk assessment process is regularly monitored and reviewed.

Control measures include provision of information, instruction, training and supervision to both operators and their supervisors. Control measures pertaining to acoustic incidents must include the incorporation of acoustic shock protection devices. Bingeman (2001) writes about the 1999 version of AS/ACIFS004 that it has been found not to offer adequate protection to the end user in circumstances of acoustic shock or excessive exposure to noise. Since the current (2001) version of AS/ACIFS004 contains the same exposure limits it is fair to say that this version also does not offer adequate protection. Telephone equipment therefore may well comply with the Standard's requirements but may still enable an acoustic shock to occur. The view that acoustic

shock protection devices be incorporated for the protection of workers is further supported by the notion that where a risk is foreseeable the employer must put in place reasonable control measures to prevent the risk. In the case of acoustic shock there have been several hundred cases reported in Australia during the last 15 years. Lesser (but still significant) numbers of acoustic shock have been reported in the UK and Denmark (HSE 2004). The risk therefore has been demonstrated and call centre managements should know these risks and implement effective control strategies.

The technology to prevent acoustic shock is improving rapidly and is now advanced to a stage where it could be reasonably expected that if properly executed, the effects can be minimised to such a degree that a telephone operator might experience annoyance rather than incapacity to continue work, or worse, devastation. In light of this it would be reasonable to expect that call centre managements incorporate such prevention systems. Failing to do so could be seen as a failing in the employer's obligation or duty of care.

Call centres should, just like other workplaces, have a reporting system for all incidents. For acoustic incidents there must be a traceable reporting system for workers who have been exposed. The reporting should as a minimum include; the time and date of the incident, a description of the noise including a way of indicating the loudness and other characteristics, the duration of exposure, the activities carried out at the time, symptoms experienced immediately and later, as related to the incident, follow-up e.g referral to audiologist, details of headset and equipment used and whether or not this equipment has been isolated. Other information may be required depending on the needs of the call centre.

It is expected that call centres would have noise surveys conducted to establish the ambient noise level in the call centres as a result of activities conducted. Depending on the proximity and number of operators in a cluster, ambient noise levels around $L_{Aeq,8h}$ 70 dB(A) have been reported as a problem for easy and effective communication with customers. Efforts should be made to reduce such ambient noise levels. This requirement is backed up by the Queensland Noise Code of Practice 2004, which has a provision stating that where noise exposure falls between $L_{Aeq,8h}$ 55dB(A) and $L_{Aeq,\ 8h}$ 85dB(A) and workers have expressed concern with this level of noise, an assessment should be conducted and if confirmed control measures be implemented.

As the business in call centres is conducted entirely on an auditory basis it is considered good practice for call centre managements to establish the hearing ability of their (prospective) telephone operators. It could be argued that this should be compulsory as a way of establishing a benchmark in the event of hearing problems developing during the worker's employment. There should also be provisions in place for situations where an operator who has experienced an acoustic shock, is clearly affected by it and has notified the supervisor of the incident, the operator can be referred to an audiologist or ear nose and throat specialist for examination in the first instance.

Since it has been demonstrated that stress is a major influence in the experience of an acoustic shock there should be evidence that stress management strategies are in place. As a minimum call centre managements need to be able to demonstrate that workers have been consulted about work conditions and circumstance they find stressful such as targets and other demands that must be met, the monitoring systems applied, the perceived control over the work situation, new telephone operators (and those returning from sick leave) start with lower target levels, feedback is provided in a consistent manner between teamleaders.

The work environment itself is an influencing factor in stress issues, eg the background noise levels, space between workers, acoustic quality of the call centre and furniture, lighting, temperature, humidity, equipment. There should also be a policy which does not allow the use of mobile phones in the call centre as these interfere with the sound reception through the headsets. Lastly the perception of a sense of wellbeing and privacy by the telephone operators also plays an important part in the experience of stress.

To assist call centre managements with compliance of their occupational health and safety obligations information should be obtained from Codes of Practice available from various statutory health and safety authorities. In Queensland the Guide to Health and Safety in the Call Centre Industry is available from www.whs.qld.gov.au

Disclaimer: The views expressed in this paper are those of the author and not necessarily of the Department of Industrial Relations.

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